United States Patent [19]

Antipov et al.

[11] **4,191,264**

[45] **Mar. 4, 1980**

[54] **IMPACT WRENCH**

[76] Inventors: **Georgy A. Antipov,** ulitsa Krasny Mayak, 3, kv. 146; **Mikhail L. Gelfand,** Yaroslavskoe shosse, 129, kv. 44, both of Moscow; **Nikolai S. Lavnikov,** ulitsa Kustanaiskaya, 117, kv. 10, Rostov-na-Donu; **Leonid N. Teres,** ulitsa 2 Koltsevaya, 61/21, Rostov-na-Donu; **Ivan I. Urazhdin,** ulitsa Engelsa, 52/56, kv. 18, Rostov-na-Donu; **Yakov I. Tsipenjuk,** ulitsa Kirova, 5, kv. 30, Solntsevo Moskovskoi oblasti; **Petr S. Yakubovsky,** Podshipnikovy pereulok, 12, kv. 36, Rostov-na-Donu, all of U.S.S.R.

[21] Appl. No.: **867,580**

[22] Filed: **Jan. 6, 1978**

[30] **Foreign Application Priority Data**

Apr. 26, 1977 [SU] U.S.S.R. 2470156

[51] **Int. Cl.**[2] **B25D 15/00**

[52] **U.S. Cl.** **173/93.6;** 64/29

[58] **Field of Search** ..... 64/27 R, 27 CS, 29; 173/12, 93, 93.5, 93.6

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,146,153	2/1939	Mathewson	64/27 CS
3,252,300	5/1966	Hofmann	64/27 CS
3,952,814	4/1976	Gelfand et al.	173/93
4,108,252	8/1978	Stroezel	64/29 X

FOREIGN PATENT DOCUMENTS

1057834	5/1959	Fed. Rep. of Germany	64/29
772674	11/1934	France	64/27 CS
45386	2/1962	Poland	64/29

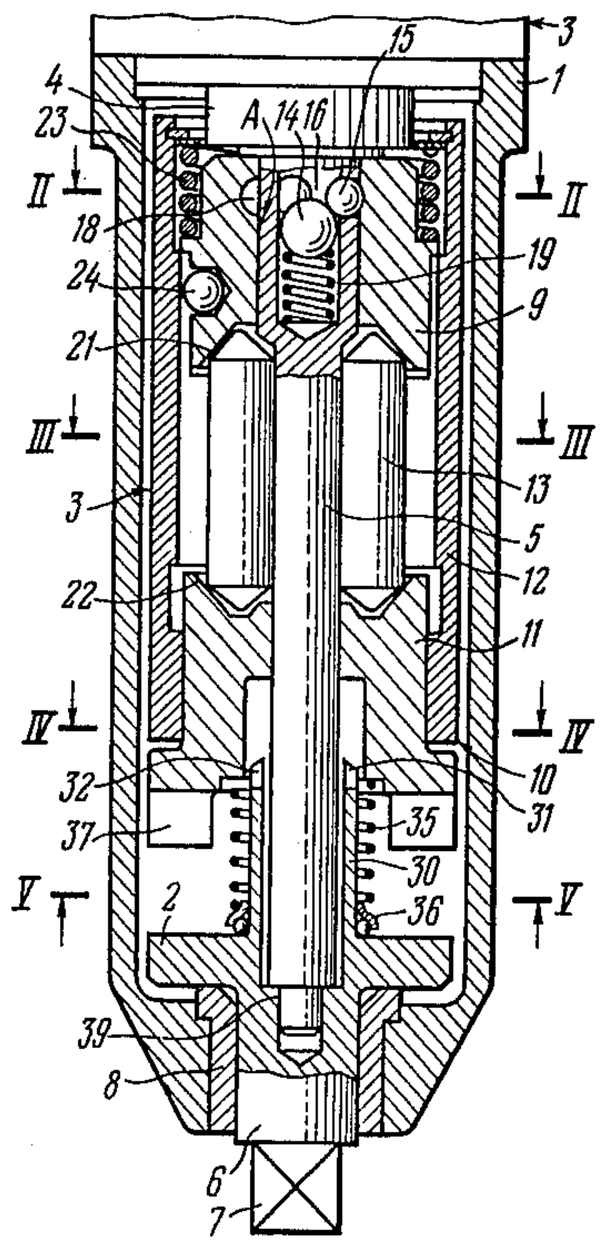
Primary Examiner—Lawrence J. Staab

Attorney, Agent, or Firm—Haseltine, Lake & Waters

[57] **ABSTRACT**

An impact wrench for tightening threaded joints by imparting a number of rotary blows to the threaded joint. The impact wrench comprises a housing which accommodates an impact clutch comprising an anvil and a hammer which consists of a driving member and a drive member, and a rotary drive of the hammer comprising an electric motor and a reduction gearing which has its output shaft mounted coaxially with the driving member of the hammer and is connected thereto for combined rotation only. The output shaft is connected to the driving member of the hammer by means of a spring-loaded pressure member accommodated in an axial bore of the output shaft and bodies of revolution contained in radial bores of the output shaft and engaging the spring-loaded pressure member. An annular groove is formed in the inner surface of the driving member of the hammer eccentrically relative thereto, and the bodies of revolution are received in the annular groove under the action of the spring-loaded pressure member.

2 Claims, 5 Drawing Figures



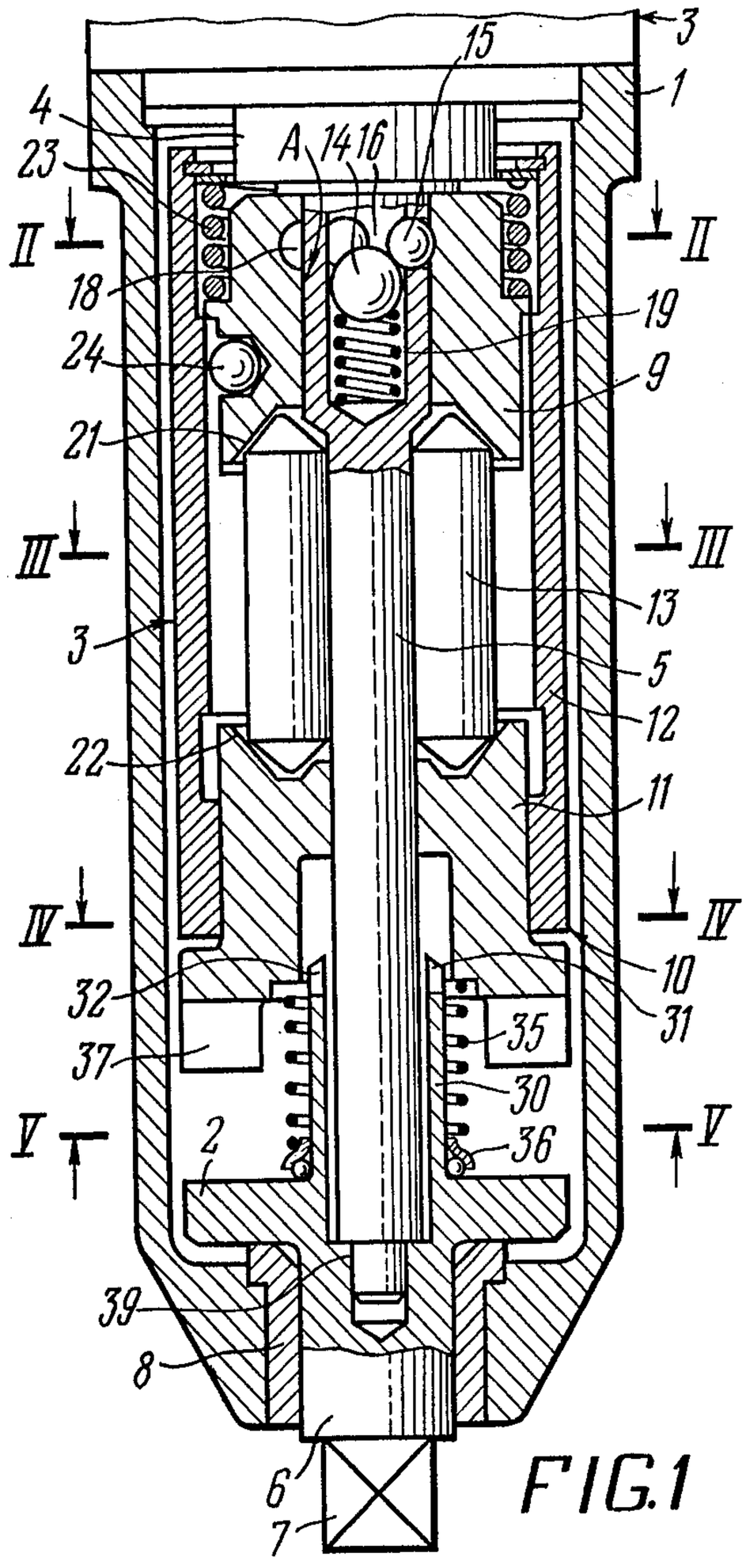

15
3
1
4
A
14
16
23
II
II
18
19
24
9
21
III
III
13
3
5
12
22
11
IV
IV
32
10
31
37
35
30
V
V
2
36
39
8
6
7

FIG.1

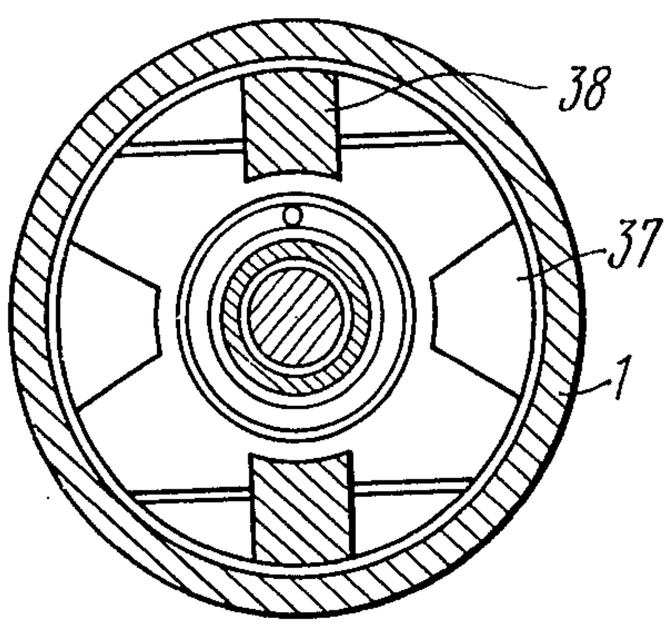


FIG.5

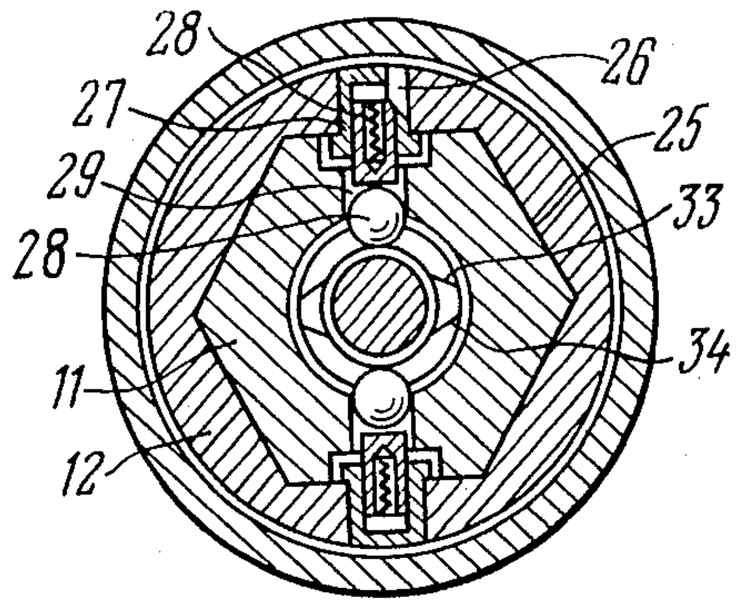


FIG.4

FIG.2

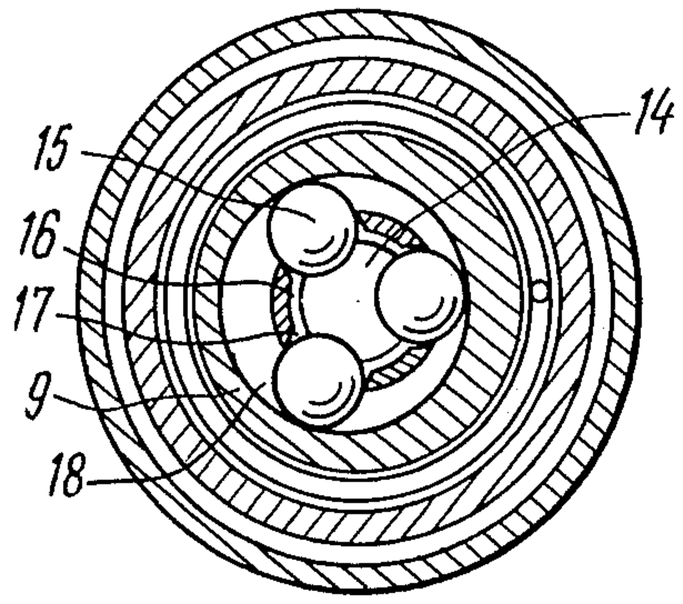
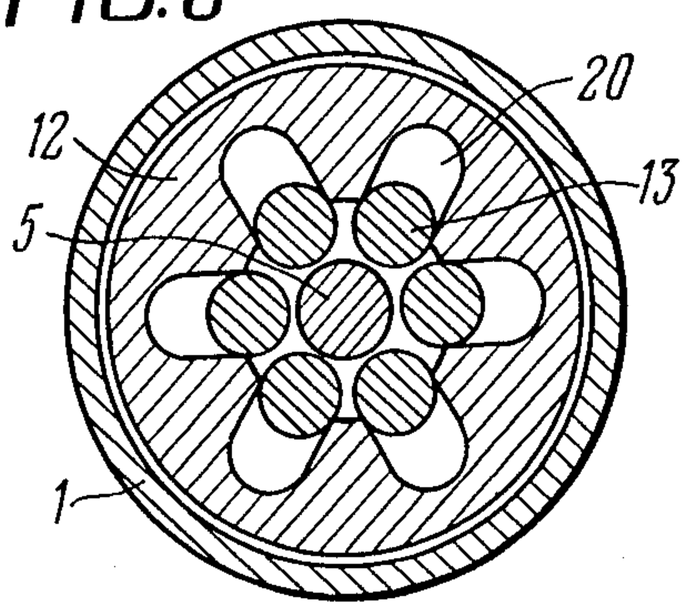


FIG.3



IMPACT WRENCH

FIELD OF THE INVENTION

The invention relates to tools used for tightening threaded joints, and more specifically to impact wrenches for torque tightening by imparting a number of blows to a threaded joint.

PRIOR ART

Known in the art are impact wrenches having a housing accommodating an impact clutch including an anvil and a hammer and a rotary drive of the hammer comprising an electric motor and a reduction gearing having an output shaft. The hammer consists of a driving member and a driven member which are interconnected for combined rotation and axial movement of the driven member relative to the driving member of the hammer for engagement with the anvil. The output shaft of the reduction gearing is mounted coaxially with the driving member of the hammer and is connected thereto for combined rotation only.

In the above-described impact wrenches, the driving member of the hammer is connected to the output shaft of the reduction gearing by means of a friction clutch which protects the electric motor against overload upon impacts (cf. U.S. Pat. No. 3,952,814). The use of the friction clutch for connecting the driving member of the hammer to the output shaft and for protecting the electric motor against overload results, however, in lower stability of the blow rate of the impact wrench due to a substantial scatter of the operating torque of the clutch thus adversely affecting the output of the tool. This disadvantage is especially pronounced when using a high-frequency induction-type motor having a more rigid characteristic than a commutator motor. In addition, the friction clutch imposes an additional load on the motor upon impacts.

The need to accommodate the clutch members in tandem with the driving member of the hammer within the impact wrench results in reduced length of the driving member of the hammer, hence in decreased mass thereof thus reducing the total mass of the parts accumulating the energy during acceleration of the hammer prior to the blow.

The use of ball-type protective clutches in impact wrenches which are able to ensure a stable operating torque is inexpedient due to increased noise (crush sound) as the clutch operates upon every blow. Additionally, the dynamic performance of such clutch results in increased vibrations. It is noted that these clutches are of large axial size (total length of the clutch members, springs and ball diameter).

Known in the art are combined ball and friction clutches. These clutches possess certain advantages over the ball-type clutches, but they are also unsuitable at high blow rate due to high noise. In addition, such clutches are complicated to manufacture.

SUMMARY OF THE INVENTION

The main object of the invention is to improve the efficiency and stability of operation of the impact wrench.

Another object of the invention is to improve reliability of protection of electric motor of the impact wrench against overload upon impact.

With these and other objects in view, in an impact wrench having a housing accommodating an impact

clutch including an anvil and a hammer which consists of a driving member and a driven member interconnected for combined rotation and for axial movement of the driven member relative to the driving member of the hammer for engagement with the anvil, and a rotary drive of the hammer comprising an electric motor and a reduction gearing having an output shaft which is mounted coaxially with the driving member of the hammer and connected thereto for combined rotation only, according to the invention, the output shaft of the reduction gearing is formed with a central axial bore accommodating a spring-loaded pressure member and radial bores communicating with the axial bore and containing bodies of revolution, and an annular groove is provided in the inner surface of the driving member of the hammer eccentrically relative thereto and opposite to the radial bores, the bodies of revolution protruding under the action of the spring-loaded pressure member being received in the annular groove, whereby the driving member of the hammer is connected to the output shaft of the reduction gearing.

Due to the above-described manner of connection of the driving member of the hammer to the output shaft, they are reliably interconnected for transmitting torque, whereas the bodies of revolution slip over the eccentric annular groove upon impact. This provides for improved efficiency and stability of operation of the impact wrench due to a low scatter of torque transmitted to the hammer. Motor overload upon impact is substantially reduced, and there is no additional noise. Furthermore, the abovedescribed connection is of a small size in cross-section so that the driving member of the hammer may be made more massive thereby increasing the mass of the components participating in the impact blow. The attachment of the driving member of the hammer to the output shaft of the reduction gearing is made more reliable and simple in construction, because the connection of these parts is now made by means of the same bodies of revolution which participate in the transmission of torque.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be now described with reference to a specific embodiment of the impact wrench according to the invention illustrated in the accompanying drawings, in which:

FIG. **1** shows a part of the impact wrench, in longitudinal section, according to the invention;

FIG. **2** is a sectional view taken along line II—II in FIG. **1**;

FIG. **3** is a sectional view taken along line III—III in FIG. **1**;

FIG. **4** is a sectional view taken along line IV—IV in FIG. **1**;

FIG. **5** is a sectional view taken along line V—V in FIG. **1**.

DETAILED DESCRIPTION

The impact wrench according to the invention comprises a housing **1** (FIG. **1**) accommodating an impact clutch including an anvil **2** and a hammer **3**, and a rotary drive of the hammer comprising an electric motor and a reduction gearing **4**. The electric motor may be of any type so that it is neither described nor shown in FIG. **1**. An output shaft **5** of the reduction gearing **4** extends through the entire housing **1** and is journalled in the anvil **2** as shown in FIG. **1**. The anvil **2** is integral with

a spindle **6** having a shank **7** for receiving a working tool (socket wrench) and journalled in a bushing **8**.

The hammer **3** is axially urged by a spring and includes a driving member **9** and a driven member **10** which consists of an inner element **11** and an outer element **12**. Flyweights **13** in the form of rods are arranged between the driving member **9** of the hammer and the inner element **11** thereof.

The output shaft **5** is mounted coaxially with the driving member **9** of the hammer and is connected thereto for combined rotation only. The output shaft **5** extends through the inner element **11** of the driven member **10** of the hammer and is journalled in the anvil **2**.

The driving member **9** of the hammer is connected to the output shaft **5** by means of a spring-loaded pressure member **14** comprising, e.g. a ball, and by means of bodies of revolution **15**, the output shaft **5** having a central axial bore **16** accommodating the spring-loaded pressure member **14** and radial bores **17** (FIG. **2**) communicating with the axial bore **16**, the number of the radial bores corresponding to the number of the bodies of revolution **15**. Each radial bore **17** contains a body of revolution **15** for engaging the pressure member **14**.

An annular groove **18** (FIG. **2**) is provided in the inner surface A (FIG. **1**) of the driving member **9** of the hammer facing the output shaft **5**, the annular groove being made eccentrically relative to the driving member of the hammer and opposite to the radial bores **17**. The bodies of revolution **15** partially protruding from the radial bores **17** under the action of the spring-loaded member **14** are received in the annular groove **18**, whereby the driving member **9** of the hammer is connected to the output shaft **5** of the reduction gearing, and the bodies of revolution **15** reliably retain the driving member **9** of the hammer from axial displacement along the output shaft **5**.

A spring **19** is disposed between the pressure member **14** (FIG. **1**) and the bottom of the bore **16** to urge the pressure member **14** against the bodies of revolution **15**.

The flyweights **13** are arranged in slots **20** (FIG. **3**) in the outer element **12** of the driven member **10** of the hammer to engage, with their respective ends, tapered surfaces **21** and **22** (FIG. **1**) of the driving member **9** of the hammer and of the inner element **11** of the hammer.

A spring **23** is provided between the driving member **9** and the outer element **12** of the driven member **10** of the hammer. The driving member **9** of the hammer and the outer element **11** are interconnected, e.g. by means of spherical keys **24** so as to rotate together and to be relatively axially movable for engagement with the anvil **2**.

The inner element **11** and the outer element **12** of the driven member **10** of the hammer are coupled at a hexagonal guide surface **25** (FIG. **4**) for combined rotation, the inner element **11** being axially movable relative to the outer element **12** of the driven member of the hammer.

The outer element **12** of the driven member has radial bores **26** accommodating locking members **27** urged by springs **28** towards the axis of the impact clutch, the locking members **27** engaging balls **28** received in bores **29** of the inner element **11** of the hammer.

The anvil **2** (FIG. **1**) has a hub **30** provided with axial cams **31** having tapers **32**, **33** and **34** (FIG. **4**). The inner element **11** of the hammer is urged, relative to the anvil **2**, by means of a spring **35** (FIG. **1**) bearing against a support **36**.

Impact jaws **37** are provided at the end face of the inner element **11** of the hammer, and respective impact jaws **38** are made on the anvil **2** (FIG. **5**). The impact jaws **37** and the locking members **27**, as well as the impact jaws **38** and the axial cams **31** are respectively oriented.

The output shaft **5** is journalled in a bore **39** of the spindle **6**.

The impact wrench operates in the following manner.

After the electric motor (not shown) of the impact wrench is energized, the output shaft **5** of the reduction gearing **4** starts rotating together with the bodies of revolution **15**. The force of the spring **19** is transmitted, via the pressure member **14**, to the bodies of revolution **15** which engage the surface of the annular groove **18** to transmit dynamic torque to the driving member **9** of the hammer. This torque is transmitted, via the balls **24**, to the driven member **10** of the hammer. At a predetermined speed of the hammer, the flyweights **13** are displaced from the center to the periphery under the action of centrifugal forces to press, with the end faces thereof, against the tapered surfaces **21**, and **22**. As a result, the inner element **11** and the outer element **12** of the driven member **10** of the hammer, which are interconnected by means of the locking members **27**, are caused to move axially towards the anvil **2** to compress the springs **23** and **35**.

Upon the displacement of the driven member **10** of the hammer, the balls **28** approach the axial cams **31**. Under the action of the tapers **32**, **33** and **34** of the cams **31**, the balls **28** are received in the bores **29** to expell the locking members **27**. The inner element **11** and the outer element **12** of the hammer are thus disengaged, and the inner element **11** of the hammer continues its movement towards the anvil **2** for engagement of the impact jaws **37** (FIG. **5**) with the respective impact jaws **38** of the anvil **2**. Upon engagement of the impact jaws **37** and **38** a blow occurs, and the accumulated kinetic energy of the rotating hammer is transmitted to a threaded joint. At the moment of impact, the bodies of revolution **15** slip over the surface of the annular groove **18** to reliably protect the electric motor against overload.

After the hammer stops, the springs **23**, **28**, **35** cause the parts of the impact clutch to return back to the initial position, and the blows are repeated at regular intervals (until the electric motor is turned off), the impact clutch functioning as described above.

We claim:

1. An impact wrench comprising a housing; an impact clutch accommodated in said housing and comprising an anvil and a hammer which includes a driving member and a driven member interconnected for combined rotation and for axial movement of the driven member relative to the driving member of the hammer for engagement with the anvil; rotary drive means for the hammer accommodated in said housing and comprising a yieldable coupling including a drive shaft having a blind bore; said driving member surrounding said drive shaft and being arranged coaxially therewith; said drive shaft having radial bores; balls arranged substantially within the blind bore and partially protruding therefrom through said radial bores; said driving member having a friction surface facing said radial bores of said drive shaft, said friction surface being constituted as a continuous inner annular groove arranged in a plane substantially at right angles to the longitudinal axis of the drive shaft and eccentrically with respect to said driving member; and a spring-loaded pressure member in said blind bore exerting axial pressure on said balls, whereby said balls engage the bottom and walls of said annular groove.

2. An impact wrench as claimed in claim **1** wherein said annular groove has a cross-section corresponding to a portion of a circle.

* * * * *